



SURFACE MODIFICATION OF PURE IRON BY ANODIC OXIDATION

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SUMMARY

The traditional paradigm of using metallic materials in biomedical applications requires, in addition to mechanical properties, the high corrosion resistance of these materials in the body. Biodegradable metals, such as iron-based alloys, broke this paradigm and became a new alternative for implantable materials. These materials corrode gradually, *in vivo*, completely dissolving after tissue healing without any residues and can be metabolized by the human body. They can be used to manufacture implants that have temporary functions in the body, such as fixation plates, screws, and stents. Degradable implants require only one intervention, avoiding a second removal operation and potentially decreasing the long-term risks and side effects caused by permanent devices. The application of iron as a biodegradable material has been demonstrated by *in vivo* studies, and although no indications of local or systemic toxicity were found, the rate of degradation of pure iron was considered to be very low. New processing and surface modification techniques, such as the growth of iron oxide nanostructures, are used to change the mechanical and degradation properties of these materials, allowing for a better response. Thus, the surface modification of a pure iron sample from the growth of nanostructures was performed using the anodic oxidation technique. This process involves the adsorption of oxygen from the electrolyte solution onto the metal, forming an oxide layer on the substrate. Depending on the material composition, potential, electrolyte, and other parameters, the result can vary from nanopores to ordered nanotubes [1]. Commercially pure iron discs 10 mm in diameter and 3 mm thick were anodized in an electrolyte solution containing 0.3% by mass of ammonium fluoride (NH₄F) and 3% by volume of deionized water and ethylene glycol,

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under a voltage of 50 V for 30 minutes and stirring at 100 rpm. In this study, samples were not calcined after anodizing. Anodized surfaces were characterized by scanning electron microscopy (SEM), energy dispersive spectrometry (EDS). For these parameters, the formed nanotubes had an average diameter of 40nm and a thickness of 6 μ m. Studies show that, in general, the increase in the thickness of the nanostructure leads to an increase in the total surface area, which generates nanotubular matrices with better drug loading capacity [2]. In this sense, the dimensions achieved for the samples anodized under these conditions can be advantageous for this type of application. The results of the chemical analysis obtained by EDS indicated the presence of fluorine, which indicates that calcination is feasible, in addition, surfaces that are only anodized do not offer adhesion of the nanostructured layer to the substrate.

REFERENCES

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